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SG1J CONFIDENTIAL/NOFORN

From: DT-ACO [redacted]
To: DT (Dr. Vorona)

Subject: Scalar Waves

Ref: Verbal Request for Summary Statement on Scalar Waves

1. (C) Per reference, the writer will provide a summary below of his understanding of the nature of scalar waves. These are unconventional waves that are not necessarily a contradiction to Maxwell's equations (as some have suggested), but might represent an extension to Maxwell's understanding at the time. If realizable, the scalar wave could represent a new form of wave propagation that could penetrate sea water, resulting in a new method of submarine communications and possibly a new form of technology for ASW. Thus the potential applications are of high interest to the U.S. R&D Community and the Intelligence Community, particularly if some promise is shown to their realizability.

2. (C/NF) There is a community in the U.S. that believes that the scalar waves are realizable. In a recent conference sponsored by the IEEE these were openly discussed and a proceedings on the conference exists. The conference was dedicated to Nicola Tesla and his work, and the papers presented claimed some of Tesla's work used scalar wave concepts. Thus there is an implied "Tesla Connection" in all of this. [redacted] SG1B

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3. (U) The scalar wave, as the writer understands, is not an electromagnetic wave. An electromagnetic (EM) wave has both electric (E) fields and magnetic (B) fields and power flow in EM waves is by means of the Poynting vector, as follows:

$$\bar{S} = \bar{E} \times \bar{B} \quad \text{watts/m}^2$$

The energy per second crossing a unit area whose normal is oriented in the direction of $\bar{S}$ is the energy flow in the EM wave.

A scalar wave has no time varying B field. (In some cases it also has no E field.) Thus it has no energy propagated in the EM wave form. It must be recognized, however, that any vector could be added that could integrate to zero over a closed surface and the Poynting theorem still applies. Thus there is some ambiguity in even stating

$$\bar{S} = \bar{E} \times \bar{B}$$

is the total EM energy flow.

4. (U) The scalar wave could be accompanied by a vector potential $\bar{A}$, and $\bar{E}$ and yet $\bar{B}$ remain zero in the far field.

From EM theory we can write as follows:

$$\left.\begin{aligned} \bar{E} &= -\nabla\phi - \frac{1}{c}\,\partial\bar{A}/\partial t \\ \bar{B} &= \nabla \times \bar{A} \end{aligned}\right\} \text{Always}$$

In this case ϕ is the scalar (electric) potential and $\bar{A}$ is the (magnetic) vector potential.

Maxwell's equations than predict

$$\nabla^2\phi - \frac{1}{c^2}\frac{\partial^2\phi}{\partial t^2} = 0 \qquad \text{(Scalar Potential Waves)}$$

$$\nabla^2\bar{A} - \frac{1}{c^2}\frac{\partial^2\bar{A}}{\partial t^2} = 0 \qquad \text{(Vector Potential Waves)}$$

A solution appears to exist for the special case of $\bar{E}=0$, $\bar{B}=0$, and $\nabla \times A=0$, for a new wave satisfying

$$\bar{A} = \nabla S$$
$$\phi = -\frac{1}{c}\frac{\partial S}{\partial t}$$

S then satisfies

$$\nabla^2 S - \frac{1}{c^2}\frac{\partial^2 S}{\partial t^2} = 0$$

Mathematically S is a "potential" with a wave equation, one that suggests propagation of this wave even through

$$\bar{E} = \bar{B} = 0$$

and the Poynting theorem indicates no EM power flow.

5. (U) From paragraph 4 above there is the suggestion of a solution to Maxwell's equations involving a scalar wave with potential S that can propagate without Poynting vector EM power flow. But the question arises as to where the energy is drawn from to sustain such a flow of energy. A vector that integrates to zero over a closed surface might be added in the theory, as suggested in para 3 above. Another is the possibility of drawing energy from the vacuum, assuming net energy could be drawn from "free space." Quantum mechanics allows random energy in free space but conventional EM theory has not allowed this to date. Random energy in free space that is built of force fields that sum to zero is a possible approach. If so, these might be a source of energy to drive the S waves drawn from "free space." A number of engineer/scientists in the community suggested in para 2 are now claiming this. A chief proponent of this is Lt Col Tom Bearden, who also lectured at the IEEE Tesla Symposium. He is known for his "Fer-de-Lance" briefing on "Soviet Scalar Weapons."

6. (U) In summary, scalar waves refer to non-EM waves with the potential for

unconventional wave propagation. They appear to have some properties of soliton waves: they may not attenuate like EM waves do. Their existence is not proven, but if they exist their energy source is not clear. They have a quantum-mechanical flavor about them.

7. (U) If such scalar waves exist than they will be transformed via collective phenomena from microscopic waves to macroscopic waves, as in the case of Josephson junction theory (Cooper pair electron effects). They will also behave like longitudinal waves in a plasma and grow via propagation on a non-optical branch of the w-k space. They will result from collective phenomena, and (as in plasma waves) grow via energy supplied by the medium (free space, sea water, etc.). Should they exist, new vistas in wave propagation and long distance ranging/detection will result.

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